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SIANGCHIN, KEVIN	
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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/836,116	Applicant(s) OTTO, ANTHONY H.
	Examiner Kevin Siangchin	Art Unit 2623

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-80* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-80* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *16 April 2001* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *4-09/04/01*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

Detailed Action

Drawings

Objections

1. The drawings are objected to because of the following. In Figs. 6-10, the ordinate axes should be labeled. Specifically, the specification (e.g. page 19, last paragraph to page 20, paragraph 1) only describes the "pixels" A, B, D, and E, depicted in these figures, as neighbors of the target pixel C. However, it appears from Figs. 6-10 that these neighboring pixels are arranged longitudinally about C, where the most distant neighbors (i.e. A and E) are two (±2) units away from C. If this is the case, then what is depicted in Figs. 6-10 is at odds with the specification where the neighbors are described as directly surrounding the target pixel. If, on the other hand, the Applicant intended to illustrate some other arrangement of neighboring pixels, then it is not entirely clear from Figs. 6-10 as to what that arrangement is – at least not without an adequate labeling of the ordinate axes. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

Objections

2. The disclosure is objected to because of the following informalities:

   a. In the table shown on page 32 of the Applicant's specification, the items TYU, TCU, TYN, and TCN are undefined.

   b. On page 19 of the Applicant's disclosure, equation 6) should read:

   $$BCr\,[i] = 225 \times 0.713 \times -0.114 \times i / 255 \approx -0.072 \times i$$

   (($0.072 \times i$) should be negative in the original equation.

3. Appropriate correction is required.

Claims

Objections

4. Claim 11 is objected to because of the following informality. The subject matter put forth in Claim 11 is completely redundant. In particular, notice that according to Claim 6, "each 4×4 square of pixels [is encoded] into a fixed bitlength block *containing a central color value, color dispersion value, ...*" (emphasis added). This is repeated again in Claim 11: "each said block contains a central color value and a color dispersion value". In this manner, Claim 11 fails to limit the subject matter of Claim 6 in any substantive way. According to C.F.R. § 1.75(c), one or more claims may be presented in dependent form, referring back to and *further limiting* another claim or claims in the same application. Appropriate correction is required.

Rejections Under 35 U.S.C. § 101: Non-Statutory Subject Matter

5. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title

6. Claims 1-80 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. Data structures (e.g. image data) not claimed as embodied in computer-readable media are descriptive material per se and are not statutory because they are not capable of causing functional change in the computer. See, for example, *In re Warmerdam*, 33 F.3d at 1361, 31 USPQ2d at 1760 (claim to a data structure per se held nonstatutory). Such claimed data structures do not define any structural and functional interrelationships between the data structure and other claimed aspects of the invention which permit the data structure's functionality to be realized. In contrast, a claimed computer-readable medium (e.g. a smart-card) encoded with a data structure defines structural **and functional interrelationships** between the data structure and the computer software and hardware components which permit the data structure's functionality to be realized, and is thus statutory.

7. While the Applicant claims that the image data is stored on the smart-card, the claims fail to set forth any explicit or implied functional interrelationship between the data and the hardware comprising the claimed smart-card. Without defining such functional interrelationships, the claimed smart-card is essentially reduced to a medium containing compressed image data – akin statutorily to a compact disc containing digitally encoded music. In either case, claims directed to such devices are non-statutory.

Rejections Under 35 U.S.C. § 112(2)

8. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

9. Claim 19, 22, 25-29, 30, 50, and 66-70 rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

10. *The following is in regard to Claim 19.*Claim 19 recites the limitation " the encoded level one blocks". There is insufficient antecedent basis for this limitation in the claim. The "encoded level one blocks" will be assumed to refer to the lower level blocks.

11. *The following is in regard to Claim 22.* Claim 22 recites the limitation "the higher level or previous frame" on lines 2-3. There is insufficient antecedent basis for this limitation in the claim.

12. *The following is in regard to Claim 25.* Claim 25 recites the limitation "the Y and Cr/Cb components". There is insufficient antecedent basis for this limitation in the claim.

13. *The following is in regard to Claim 26.* Claim 26 recites the limitation "pattern blocks". There is insufficient antecedent basis for this limitation in the claim. Claim 26 will be treated as though the definition of this term from Claim 22 were present.

14. *The following is in regard to Claim 27.* Claim 27 recites the limitation "uniform chroma blocks". There is insufficient antecedent basis for this limitation in the claim. Claim 27 will be treated as though the definition of this term from Claim 22 were present.

15. *The following is in regard to Claim 28.* Claim 28 recites the limitation "uniform blocks". There is insufficient antecedent basis for this limitation in the claim. Claim 28 will be treated as though the definition of this term from Claim 22 were present.

16. *The following is in regard to Claim 29.* Claim 29 recites the limitation "null blocks". There is insufficient antecedent basis for this limitation in the claim. Claim 29 will be treated as though the definition of this term from Claim 22 were present.

17. *The following is in regard to Claims 66-69.* These claims contain the limitations as Claims 26-29, respectively. They, therefore, suffer from the same antecedent-basis issues.

18. Note that, with regard to Claims 26-29 and 66-69, the antecedent basis issues could be easily overcome by making these sets of claims dependant on Claim 22 and Claim 64, respectively.

19. *The following is in regard to Claim 30.* Claim 30 recites the limitation "the texture map". There is insufficient antecedent basis for this limitation in the claim.

20. *The following is in regard to Claim 50.* Claim 50 recites the limitations "said background mask set" (e.g. line 2). There is insufficient antecedent basis for this limitation in the claim.

21. *The following is in regard to Claim 70.* Claim 70 recites the limitation "the texture map". There is insufficient antecedent basis for this limitation in the claim.

<u>Preface</u>

22. Before proceeding, a brief discussion is in order regarding how the claimed subject will be interpreted and treated in this document. The Claims are drawn to a smart-card for storing a compressed digital image. The claimed smart-card, generally, comprises image data and a memory that stores the said image data. With the exception of Claims 2 and 35, all the claims propose various manifestations of the image data, particularly with respect to its representation (e.g. the manner in which it has been compressed, the manner in which it has been filtered, etc.). It should be understood, however, that the image data, regardless of its representation, does not, in and of itself, introduce or imply additional structure into the claimed smart-card. (Claims 2 and 35, on the hand, impress a definitive structure upon the claimed smart-card – i.e. that the memory be of a specific type). For example, the image data could have been converted, filtered, segmented and compressed, in the manner proposed in the claims,

by a separate device, external to the claimed smart-card (e.g. on a computer or a device used to prepare the card). Therefore, all the Claims, besides Claim 2 and 35, can be legitimately treated as *functional limitations* of the claimed smart-card, as opposed to *structural limitations* thereof. While features of an apparatus may be recited either structurally of functionally, claims directed to an apparatus must be distinguished over prior art in terms of structure, rather than function alone. See MPEP § 2114. See also *In re Schreiber*, 128 F.3d 1473, 1477-78, 44 USPQ2d 1429, 1431-32 (Fed. Cir. 1997) and *In re Swinehart*, 439 F.2d 210, 212-13, 169 USPQ 226, 228-29 (CCPA 1971). Though the various claimed representations of the image data – or more precisely, the methodologies proposed by the Applicant to obtain them – may distinguish themselves over prior art, it should be clear that any smart-card capable of storing image data would, in turn, be capable of storing the image data of the Applicant's claimed invention. In other words, any such prior art smart-card would satisfy the structural limitations set forth in the Claims. This is shown below. An attempt will be made, however, to show that prior art does indeed anticipate at least some aspects of the proposed image data. This does not, however, diminish the validity of the preceding discussion.

Non-Statutory Double Patenting

23. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

24. A timely filed terminal disclaimer in compliance with 37 C.F.R. § 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 C.F.R. § 1.130(b).

25. Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 C.F.R. § 3.73(b).

26. Claims 1-5 and 34-35, 40-42 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claims 1-4 of U.S. Patent No. 6,244,514. An obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but an examined application claim is not patentably distinct from the reference claim(s) because the examined claim is either anticipated by, or would have been obvious over, the reference claim(s). See, for example, *In re Berg,* 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman,* 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi,* 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985).

27. *The following is in regard to Claim 1.* Although the conflicting claims are not identical, they are not patentably distinct from each other because the subject matter set forth Claim 1 of U.S. Patent 6,244,514 falls entirely within the scope of Claim 1 of the present application (i.e. Claim 1 of the present application is anticipated by Claim 1 of U.S. Patent 6,244,514).

28. *The following is in regard to Claim 2.* Although the conflicting claims are not identical, they are not patentably distinct from each other because the subject matter set forth in Claim 2 of U.S. Patent 6,244,514 falls entirely within the scope of Claim 2 of the present application (i.e. Claim 2 of the present application is anticipated by Claim 2 of U.S. Patent 6,244,514).

29. *The following is in regard to Claim 3.* Although the conflicting claims are not identical, they are not patentably distinct from each other because the subject matter set forth in Claim 1 of U.S. Patent 6,244,514 falls entirely within the scope of Claim 3 of the present application (i.e. Claim 3 of the present application is anticipated by Claim 1 of U.S. Patent 6,244,514). Specifically, both claims put forth a smart-card comprising image data, wherein said image data is filtered by evaluating each of the individual pixels as a target pixel and a plurality of pixels in close proximity to the target pixel to determine an output value for the target pixel. In the case of Claim 1 of U.S. Patent 6,244,514, the window of pixels immediately surrounding the target pixel constitutes a plurality of pixels in close proximity to the target pixel.

30. *The following is in regard to Claim 4.* Although the conflicting claims are not identical, they are not patentably distinct from each other because the subject matter set forth in Claim 1 of U.S. Patent 6,244,514 falls

entirely within the scope of Claim 4 of the present application (i.e. Claim 4 of the present application is anticipated by Claim 1 of U.S. Patent 6,244,514).

31. *The following is in regard to Claim 5.* Although the conflicting claims are not identical, they are not patentably distinct from each other because the subject matter set forth in Claim 1 of U.S. Patent 6,244,514 falls entirely within the scope of Claim 5 of the present application (i.e. Claim 5 of the present application is anticipated by Claim 1 of U.S. Patent 6,244,514). In particular, notice that the "two pixels on the matching side that fall within the specified range" of Claim 1 of U.S. Patent 6,244,514 (U.S. Patent 6,244,514 column 12, lines 33-34) represent "two neighboring pixels closest in value to the target pixel values that fall within the specified range" (lines 12-13 of Claim 5 of the present application). The Applicant should also realize that "a small range to account for ringing or pre-emphasis typically found in analog video signals" (Claim 1 of U.S. Patent 6,244,514 – U.S. Patent 6,244,514 column 12, lines 35-38) represents a "specified range" (line 14 of Claim 5 of the present application).

32. *The following is in regard to Claim 34.* Although the conflicting claims are not identical, they are not patentably distinct from each other because the subject matter set forth Claim 3 of U.S. Patent 6,244,514 falls entirely within the scope of Claim 34 of the present application (i.e. Claim 34 of the present application is anticipated by Claim 3 of U.S. Patent 6,244,514).

33. *The following is in regard to Claim 35.* Although the conflicting claims are not identical, they are not patentably distinct from each other because the subject matter set forth Claim 4 of U.S. Patent 6,244,514 falls entirely within the scope of Claim 35 of the present application (i.e. Claim 35 of the present application is anticipated by Claim 4 of U.S. Patent 6,244,514).

34. *The following is in regard to Claim 40.* Although the conflicting claims are not identical, they are not patentably distinct from each other because the subject matter set forth Claim 3 of U.S. Patent 6,244,514 falls entirely within the scope of Claim 40 of the present application (i.e. Claim 40 of the present application is anticipated by Claim 3 of U.S. Patent 6,244,514).

35. *The following is in regard to Claim 41.* Although the conflicting claims are not identical, they are not patentably distinct from each other because the subject matter set forth Claim 3 of U.S. Patent 6,244,514 falls entirely within the scope of Claim 35 of the present application (i.e. Claim 41 of the present application is anticipated by Claim 3 of U.S. Patent 6,244,514).

36. *The following is in regard to Claim 42.* Although the conflicting claims are not identical, they are not patentably distinct from each other because the subject matter set forth Claim 3 of U.S. Patent 6,244,514 falls entirely within the scope of Claim 35 of the present application (i.e. Claim 42 of the present application is anticipated by Claim 3 of U.S. Patent 6,244,514).

37. Note that Claims 34-35 and 40-42 of the present application put forth essentially the same subject matter as Claims 1-2 and 3-5, respectively. (Claims 34-35 and 40-42 merely limit the scalar values to color values). Therefore, arguments relating Claims 1-2 and 3-5 are applicable to Claims 34-35 and 40-42, respectively.

38. Claims 20-28, 30, 36-39, 43, 62-68 and 70 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claim 2, 5-7, 13-18, and 22-35 of U.S. Patent No. 6,356,588, in view of Ray et al. [089] (U.S. Patent 5,727,089). An obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but an examined application claim is not patentably distinct from the reference claim(s) because the examined claim is either anticipated by, or would have been obvious over, the reference claim(s). See, for example, *In re Berg,* 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman,* 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi,* 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985).

39. Generally speaking, U.S. Patent 6,356,588 discloses and makes claim to a method for digital compression of an image, whereas, the claims of the present application are directed to a smart-card for storing compressed digital images. In most of the claims of the present application, the substantive and essential aspects of the claimed subject matter relate primarily to the various methodologies used to encode, filter, or otherwise manipulate the representation of the stored digital image. Therefore, with regard to rejections below, the various methods claimed in U.S. Patent 6,356,588 address the substantive and essential aspects of the respective claims of the present application, although the claims of U.S. Patent 6,356,588 may lack any specific mention of a smart-card. However, at the time of the Applicant's claimed invention, it was known to store compressed digital image data on a smart-card. This is discussed by Ray et al. [089] (Ray et al. [089] Abstract). (The memory of Ray et al. [089]'s smart-card comprises a programmable microchip – Ray et al. [089] column 3, lines 15-20). Smart-cards having digital image data stored thereon are advantageous because they allow physical portability of that image data, which may, in turn,

facilitate the usage of the data for, say, identification purposes in financial transaction or POS applications (Ray et al. [089] column 1, lines 32-38 and paragraph 1 of the *Summary of the Invention*). Because of the slight physical dimensions of a smart-card, the card's memory capacity is limited and efficient memory utilization becomes critical. These circumstances, therefore, necessitate the usage of *compressed* image data.. Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to use the various claimed encoding and compression methods of U.S. Patent 6,356,588 to compress the image data stored on a smart-card. This line of reasoning applies generally to the obviousness-type double-patenting rejections that follow and will not be repeated.

40. Claims 7-10 and 36-39 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claims 22-25 of U.S. Patent No. 6,356,588, in view of Ray et al. [089] (U.S. Patent 5,727,089).

41. *The following is in regard to Claim 7.* Although the image data of the conflicting claims are not identical, they are not patentably distinct from each other because the definition of that image data set forth in Claim 22 of U.S. Patent 6,356,588 falls entirely within the scope of its definition found in Claim 7 of the present application.

42. *The following is in regard to Claim 8.* Although the image data of the conflicting claims are not identical, they are not patentably distinct from each other because the definition of that image data set forth in Claim 23 of U.S. Patent 6,356,588 falls entirely within the scope of its definition found in Claim 8 of the present application.

43. *The following is in regard to Claim 9.* Although the image data of the conflicting claims are not identical, they are not patentably distinct from each other because the definition of that image data set forth in Claim 24 of U.S. Patent 6,356,588 falls entirely within the scope of its definition found in Claim 9 of the present application.

44. *The following is in regard to Claim 10.* Although the image data of the conflicting claims are not identical, they are not patentably distinct from each other because the definition of that image data set forth in Claim 25 of U.S. Patent 6,356,588 falls entirely within the scope of its definition found in Claim 10 of the present application.

45. *The following is in regard to Claims 36-39.* With regard to these claims, arguments analogous to those presented above relating to Claims 7-10 are applicable. (Claims 36-39 and Claims 7-10 differ primarily in that the image data of Claims 36-39 corresponds specifically to a color image).

46. Claims 20-22 and 62-64 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claim 5 of U.S. Patent No. 6,356,588, in view of Ray et al. [089] (U.S. Patent 5,727,089).

47. *The following is in regard to Claim 20.* Although the image data of the conflicting claims are not identical, they are not patentably distinct from each other because the definition of that image data set forth in Claim 5 of U.S. Patent 6,356,588 falls entirely within the scope of its definition found in Claim 20 of the present application. See Claim 20 of the present application and U.S. Patent 6,356,588 column 14, lines 1-9.

48. *The following is in regard to Claim 21.* Although the image data of the conflicting claims are not identical, they are not patentably distinct from each other because the definition of that image data set forth in Claim 5 of U.S. Patent 6,356,588 falls entirely within the scope of its definition found in Claim 21 of the present application. See Claim 21 of the present application and U.S. Patent 6,356,588 column 14, lines 6-7.

49. *The following is in regard to Claim 22.* Although the image data of the conflicting claims are not identical, they are not patentably distinct from each other because the definition of that image data set forth in Claim 5 of U.S. Patent 6,356,588 falls entirely within the scope of its definition found in Claim 22 of the present application. See Claim 21 of the present application and U.S. Patent 6,356,588 Claim 5.

50. *The following is in regard to Claims 62-64.* With regard to these claims, arguments analogous to those presented above relating to Claims 20-22 are applicable. (Claims 62-64 and Claims 20-22 differ only in that the image data of Claims 62-64 corresponds specifically to a color image).

51. Claim 23 is rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claim 13 of U.S. Patent No. 6,356,588, in view of Ray et al. [089] (U.S. Patent 5,727,089).

52. *The following is in regard to Claim 23.* Although the image data of the conflicting claims are not identical, they are not patentably distinct from each other because the definition of that image data set forth in Claim 13 of U.S. Patent 6,356,588 falls entirely within the scope of its definition found in Claim 23 of the present application. See Claim 23 of the present application and U.S. Patent 6,356,588 Claim 13.

53. Claims 24-25 and 65 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claim 14 of U.S. Patent No. 6,356,588, in view of Ray et al. [089] (U.S. Patent 5,727,089).

54. *The following is in regard to Claim 24.* Although the image data of the conflicting claims are not identical, they are not patentably distinct from each other because the definition of that image data set forth in Claim 14 of U.S. Patent 6,356,588 falls entirely within the scope of its definition found in Claim 24 of the present application. Specifically, "reducing the number of bits for the Y and Cr/Cb components independently for each classification" (Claim 14 of U.S. Patent 6,356,588) amounts to "defining the number of bits to be preserved [by determining] for each component [e.g. the Y and Cr/Cb components] of the block according to the classification of the block to preserve a desired number of bits for the block".

55. *The following is in regard to Claim 25.* Although the image data of the conflicting claims are not identical, they are not patentably distinct from each other because the definition of that image data set forth in Claim 14 of U.S. Patent 6,356,588 falls entirely within the scope of its definition found in Claim 25 of the present application.

56. *The following is in regard to Claim 65.* With regard to this claim, arguments analogous to those presented above relating to Claim 25 are applicable. (Claims 65 and Claims 25 differ only in that the image data of Claims 65 corresponds specifically to a color image).

57. Claims 26-28 and 66-68 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claims 16-18 of U.S. Patent No. 6,356,588, in view of Ray et al. [089] (U.S. Patent 5,727,089).

58. *The following is in regard to Claim 26.* Although the image data of the conflicting claims are not identical, they are not patentably distinct from each other because the definition of that image data set forth in Claim 16 of U.S. Patent 6,356,588 falls entirely within the scope of its definition found in Claim 26 of the present application.

59. *The following is in regard to Claim 27.* Although the image data of the conflicting claims are not identical, they are not patentably distinct from each other because the definition of that image data set forth in Claim 17 of U.S. Patent 6,356,588 falls entirely within the scope of its definition found in Claim 27 of the present application.

60. *The following is in regard to Claim 28.* Although the image data of the conflicting claims are not identical, they are not patentably distinct from each other because the definition of that image data set forth in Claim 18 of U.S. Patent 6,356,588 falls entirely within the scope of its definition found in Claim 28 of the present application.

61. *The following is in regard to Claims 66-68.* With regard to these claims, arguments analogous to those presented above relating to Claims 26-28, respectively, are applicable. (Claims 66-68 and Claims 26-28 differ only in that the image data of Claims 66-68 corresponds specifically to a color image).

62. Claims 30 and 70 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claim 15 of U.S. Patent No. 6,356,588, in view of Ray et al. [089] (U.S. Patent 5,727,089).

63. *The following is in regard to Claim 30.* Although the image data of the conflicting claims are not identical, they are not patentably distinct from each other because the definition of that image data set forth in Claim 15 of U.S. Patent 6,356,588 falls entirely within the scope of its definition found in Claim 30 of the present application.

64. *The following is in regard to Claims 70.* With regard to this claim, arguments analogous to those presented above relating to Claim 30 are applicable. (Claims 70 and Claims 30 differ only in that the image data of Claim 70 corresponds specifically to a color image).

65. Claim 43 is rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claim 2 of U.S. Patent No. 6,356,588, in view of Ray et al. [089] (U.S. Patent 5,727,089).

66. *The following is in regard to Claim 43.* Although the image data of the conflicting claims are not identical, they are not patentably distinct from each other because the definition of that image data set forth in Claim 2 of U.S. Patent 6,356,588 falls entirely within the scope of its definition found in Claim 43 of the present application.

67. Claims 6, 11-13 and 52-54, and 57 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claims 6-7 of U.S. Patent No. 6,356,588, in view of Ray et al. [089] (U.S. Patent 5,727,089), in further view of [Delp79] (Delp and Mitchell, "Image Compression Using Block Truncation Coding", IEEE 1979). An obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but an examined application claim is not patentably distinct from the reference claim(s) because the examined claim is either anticipated by, or would have been obvious over, the reference claim(s). See, for example, *In re Berg,* 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman,* 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi,* 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985).

68. *The following is in regard to Claim 6* [1]. Claim 6 of the present application proposes statistically encoding the image data by "dividing the image into an array of 4×4 squares of pixels, and encoding each 4×4 square of pixels into a fixed bitlength block containing a central color value, color dispersion value, and a selection map that represent the sixteen pixels in the block". (Presumably, the central color value, color dispersion value, and selection map would have to be determined). Similarly, Claim 6 of U.S. Patent No. 6,356,588 proposes that statistically encoding the image data comprises determining a central color value (i.e. "a first sample moment of each block as the arithmetic mean of the pixels in the block"), determining a color dispersion value[2] (i.e. "a second sample moment of the pixels in the block"), and determining a selection map of those pixels in the block having color values darker or lighter than a quantizer set to the first sample moment. While Claim 6 of U.S. Patent No. 6,356,588

1 Recall that given the teachings of Ray et al., it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to store the various image data, obtained by the various claimed methodologies of U.S. Patent 6,356,588, on a smart-card. The details were given above and will not be repeated in the subsequent obviousness-type double-patenting rejections.

2 The mean clearly represents a "central color value". For a given set of samples characterized by a probability distribution, the second moment (about the mean) is often referred to as the *variance.* The variance is measure of dispersion of samples about the mean. Since the present discussion relates to samples of colors, the variance represents, in this manner, "a color dispersion value".

does propose "dividing the color image into an array of blocks of pixels" and "encoding each block of pixels into a fixed number of bits [i.e. a 'fixed bitlength block'] that represent the pixels in the block" (by virtue on its dependence on Claim 1 U.S. Patent No. 6,356,588), it does not suggest that the blocks consist of 4×4 squares of pixels nor that the encoded blocks include the central color value, color dispersion value and selection map.

69. [Delp79] proposes the so-called *block-truncation coding* (BTC) method for compressing image data. The method entails "dividing the image into an array of 4×4 squares of pixels" ([Delp79], Section II, sentence 1), and "encoding each 4×4 square of pixels into a fixed bitlength block" (e.g. [Delp79], page 1336, right column, lines[3] 5-10) containing: "a central color value" (i.e. $\overline{X}$ – [Delp79] equation (1)), "color dispersion value" ($\overline{\sigma}^2$ – [Delp79] equation (1)), and a "selection map that represent the sixteen pixels in the block" (i.e. a $n \times n$ bit plane – [Delp79], page 1336, right column, lines 3-4).

70. Given [Delp79], it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to extend the method of Claim 6 of U.S. Patent No. 6,356,588 (as applied to a smart-card in accordance with the teachings of Ray et al. [089]) such that blocks consist of 4×4 squares of pixels and the encoded blocks include the central color value, color dispersion value and selection map. This would have made the method of Claim 6 of U.S. Patent No. 6,356,588 compliant with the BTC method of compression, which is known to be efficient and effective at the compression of image data (see [Delp79], Section V. *Performance Evaluation of BTC*). For these reasons, Claim 6 of the present application cannot be considered patentably distinct over Claim 6 of U.S. Patent No. 6,356,588.

71. *The following is in regard to Claim 11.* Claim 11 of the present application cannot be considered patentably distinct over Claim 6 of U.S. Patent No. 6,356,588, in light of the teachings of [Delp79] and Ray et al. [089] This follows directly from the discussion above with regard to Claim 6.

72. *The following is in regard to Claim 12.* Claim 12 of the present application cannot be considered patentably distinct over Claim 6 of U.S. Patent No. 6,356,588, in light of the teachings of [Delp79] and Ray et al. [089] This follows directly from the discussion above with regard to Claim 6.

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3 Lines are counted sequentially from the top beginning with 1. An equation is treated as a single line, regardless of its length. Images and their associated captions are not counted.

73. *The following is in regard to Claim 13.* Claim 13 of the present application cannot be considered patentably distinct over Claim 6 of U.S. Patent No. 6,356,588, in light of the teachings of [Delp79] and Ray et al. [089] This follows directly from the discussion above with regard to Claim 6.

74. *The following is in regard to Claims 52, 53-54 and 57.* With regard to these claims, arguments analogous to those presented above relating to Claims 6, 11-12 and 13, respectively, are applicable. (Claims 52, 53-54 and 57 and Claims 6, 11-12 and 13 differ only in that the image data of Claims 52, 53-54 and 57 corresponds specifically to a color image).

75. *The following is in regard to Claim 55.* Note that, with the exception of limitations of the blocks consisting of 4×4 squares of pixels and the encoded blocks including the central color value, color dispersion value and selection map (inherited from Claim 52 of the present application), the subject matter of Claim 7 of U.S. Patent 6,356,588 falls sufficiently within the scope of Claim 55 of the present invention. Heeding the discussion above relating to Claim 6, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to extend the method of Claim 7 of U.S. Patent 6,356,588 such that blocks consist of 4×4 squares of pixels and the encoded blocks include the central color value, color dispersion value and selection map. Taking this into account, Claim 55 of the present application cannot be considered patentably distinct over Claim 7 of U.S. Patent No. 6,356,588, in view of the teachings of [Delp79] and Ray et al. [089].

Rejections Under 35 U.S.C. § 103(a)[4]

76. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

77. Claims 1-80 are rejected under 35 U.S.C. 103(a) as being unpatentable over Weiss (U.S. Patent 5,821,983).

4 Note that analogous non-statutory double-patenting rejections could have been made based upon the prior art that serves the basis for the following rejections.

78. *The following is in regard to Claims 1, 34, 62, and 72.* Weiss disclose a smart-card (e.g. Weiss Fig. 1, smart-card 108) for storing a digitally compressed image (Weiss column 4, lines 41-53). The disclosed smart-card includes image data (Weiss column 4, lines 56-57) and a memory (e.g. EEPROM 102 shown in Weiss Fig. 2) for storing the image data (Weiss column 4, lines 56-57).

79. As discussed above, the image data and the various processes undergone to obtain that data do not, in and of themselves, introduce or imply additional structure in the smart-card. Clearly, the smart-card of Weiss possesses the requisite structural elements for storing the compressed image data of Claim 1. Following the discussion given in the Preface above, the smart-card of Weiss. would then satisfy all structural limitations of Claim 1. Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to store the image data of Claim 1 on the smart-card of Weiss.

80. Similar arguments can be made for independent Claims 34, 62, and 72.

81. *The following is in regard to 2 and 35.* As shown above, the smart-card of Weiss adequately satisfies the limitations of Claims 1 and 34. Furthermore, the memory of Weiss' smart-card is an EEPROM (Electrically-Erasable Programmable Read-Only Memory). It, therefore, constitutes a memory comprising a programmable microchip.

82. *The following is in regard to Claims 3-33, 36-61, and 63-72.* These claims impose further limitations on the image data stored on the smart card. Again, such limitations do not, in and of themselves, imply the existence of additional structural elements in the claimed smart-card(s). The image data, regardless of how it is manifested or manipulated according to the claims, may just as well be stored on the smart-card of Weiss' teachings. In this manner, the smart-card of Weiss satisfies all of the structural limitations of these claims.

Smart-Card

83. Claims 1-4, 32, 34-35, 40-41, and 72 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ray et al. [089] in view of Anastassiou et al. (U.S. Patent 4,504,864).

84. *The following is in regard to Claims 1 and 34.* As shown above Ray et al. [089] discloses a smart card for storing compressed digital image data. The digital image contains image data consisting of a plurality of scan lines of pixels with scalar values (e.g. color or intensity values). This is typical of all digital images. In addition, the smart-card comprises the following elements:

(1.a.) Image data in "compressed format" (Ray et al. [089] column 3, lines 12-14), compressed using various *vector quantization* (VQ) methods (Ray et al. [089] column 3, lines 53-54).

(1.b.) A memory (e.g. reference number 14 in Ray et al. [089] Fig. 1) storing said image data

VQ is known to be a compression method based on the principle of *block encoding.* As such, VQ involves assigning a fixed-length code to a block (e.g. of image data) having predefined dimensions. Vector quantizers are typically based on a known probabilistic (statistical) model or long sequences of training data. Despite this, Ray et al. [089] do not expressly show or suggest that the image data be:

> Filtered by evaluation of the scalar values of individual pixels in the image with respect to neighboring pixels.

85. Filtering image data (e.g. to remove noise from the image data) prior to compressions is well-known and often practiced. Image filters often evaluate the values of pixels neighboring a given pixel. For example, Anastassiou et al. show this. Anastassiou et al. disclose a non-linear filter for image data (Anastassiou et al. Fig. 1) that evaluates the scalar values of individual pixels in the image with respect to neighboring pixels (Anastassiou et al. equations (1)-(3) and column 5, lines 1-20). Anastassiou et al. suggests utilizing the filter as pre-processing step prior to compression (Anastassiou et al. column 6, lines 15-26).

86. It would have been, therefore, obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to use a filter, such as that of Anastassiou et al., to preprocess the image prior to compression in order to advantageously remove artifacts present in the image (e.g. "sawthooth" artifacts – Anastassiou et al. column 6, lines 15-18). This would have the effect of improving data compression and the image quality (Anastassiou et al. column 6, lines 23-26).

87. Analogous arguments hold for Claim 34.

88. *The following is in regard to Claims 2 and 35.* The smart-card of Ray et al. [089] includes an integrated circuit 14 (Ray et al. [089] Fig. 1), capable of data storage, imbedded in the card (Ray et al. [089] column 3, lines 15-17). It is well known that such integrated circuits (e.g. EEPROMs) are often programmable.

89. *The following is in regard to Claims 3 and 40.* The filter of Anastassiou et al. evaluates each said individual pixel as a target pixel[5] (e.g. *current pel*[6] – Anastassiou et al., column 3, lines 56-58) and a plurality of pixels in close proximity to the target pixel (e.g. *nearest neighbors*, V_{n-1} and V_{n+1} – see Anastassiou et al., column 3, equation 1 and column 4, lines 46-51; see also Anastassiou et al. column 5, lines 1-20) to determine an output value for the target pixel (Anastassiou et al. column 3, lines 55-67 to column 4, lines 1-11).

90. *The following is in regard to Claim 4 and 41.* As previously discussed, the filter of Anastassiou et al. evaluates a current pel (i.e. a "target" pixel) and the set of nearest neighbors. The set of nearest neighbors of a given pixel is often defined as the *4-neighborhood* of that pixel as shown below:

$$\begin{array}{ccc} & V_{n+2} & \\ V_{n-1} & \boxed{V_n} & V_{n+1} \\ & V_{n+3} & \end{array}$$

91. Clearly, the 4-neighborhood comprises five pixels – two pixels on either side of the target pixel (V_n) and the target pixel itself. Therefore, though not explicitly stated by Anastassiou et al., the following is inherent to the disclosed filter: image data is filtered by evaluating a sequence of five pixels, including two pixels on either side of the target pixel and the target pixel itself, for each said target pixel.

92. *The following is in regard to Claim 32.* The "datastream" associated with the encoded image is stored in block order in the smart-card of Ray et al. [089]. See Ray et al. [089] Figs. 5-6 and 8.

93. *The following is in regard to Claim 72.* Notice that the subject matter set forth in Claim 72 merely combines the subject matter of Claim 1 with that of Claim 32. Therefore, with regard to Claim 72, arguments presented previously relating to Claim 32 are applicable.

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5 "Target pixel" is merely a label. Such a designation does substantively change the definition or concept of the "said individual" pixels. It will, therefore, not be treated any further.

6 The term *pel* is an older, less frequently used term for picture element (pixel). Pixel and pel will be used interchangeably in this document.

Block Order

94. Claims 73 and 80 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ray et al. [089] in view of Anastassiou et al. (U.S. Patent 4,504,864), in further view of Ray et al. [573] (U.S. Patent 5,574,573).

95. *The following is in regard to Claim 73*[7]. As shown above, encoded image data is stored in the smart-card of Ray et al. [089] in block order. However, neither Ray et al. [089], nor Anastassiou et al. expressly disclose storing in block order to first process those portions of the image that are most important to facial identification.

96. Ray et al. [573] propose a smart-card that is essentially the same as that which is disclosed in Ray et al. [089]. The disclosure of Ray et al. [573] expounds on the VQ compression method discussed in Ray et al. [089]. According to Ray et al. [573], the location (or order) of blocks (Ray et al. [573] Fig. 6) in an image is "based on their anticipated contents and their predetermined importance in the identification of individuals from portraits" (Ray et al. [573], column 7, lines 28-32). The VQ algorithm proposed by Ray et al. [573] uses this arrangement both in the recognition of the individual and the development of specialized codebooks for particular regions of the image. According to Ray et al. [573], this yields significant improvements in image quality (Ray et al. [573], column 7, lines 36-38), as well contributing to the recognition process (Ray et al. [573], column 7, lines 32-33). Given this, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to store the image on the smart-card in block order to first process those portions of the image that are most important to facial identification.

97. *The following is in regard to Claim 80.* Ray et al. [573] groups blocks into different regions corresponding to certain parts of the face. See Ray et al. [573], column 6, last paragraph and Fig. 6. According to Ray et al. [573] (Ray et al. [573], column 7, lines 32-34), more bits are allocated to those regions that are deemed to contribute to identification (e.g. regions labeled as '9' in Ray et al. [573] Fig. 6 – see Ray et al. [573], column 6, lines 66-67 to column 7, lines 1-3). This "specialization" results in significant improvement in image quality (Ray et al. [573], column 7, lines 35-38) and compression rates. Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to divide the blocks into groups or regions of the face.

7 Please notice that Claim 73 only functionally limits the claimed smart-card. Accordingly, the combination of Ray et al. [089] and Anastassiou et al. could alone address the subject matter of Claim 73.

98. Claims 74-79 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ray et al. [089] in view of Anastassiou et al. (U.S. Patent 4,504,864), in further view of Rosenberg (U.S. Patent 5,832,115).

99. *The following is in regard to Claim 76.* As shown above, encoded image data is stored in the smart-card of Ray et al. [089] in block order. However, neither Ray et al. [089] nor Anastassiou et al. expressly show a block order providing an oval group layout.

100. Rosenberg discloses a method for carrying out block-based search operations for facial ellipses. The method is applied to facial image compression (Rosenberg Abstract and paragraph of the *Detailed Description of the Preferred Embodiment*). Rosenberg stores image data in a block order having an oval (ellipse) "group layout". See Rosenberg Figs. 5A-5B, column 13: lines 10-16, and column 16, lines 7-15. Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to store image data on a smart-card in a block order that provides an elliptical "group layout". This would advantageously allows the image to be stored in a manner that locates and delimits an elliptical region in the image corresponding to a face.

101. *The following is in regard to Claim 74.* Although not explicitly shown in Rosenberg, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to store the encoded image in a block order that provides a circle "group layout" because a circle is a type of ellipse that resembles the outline of many human faces.

102. *The following is in regard to Claim 78.* Though such a layout is not elliptical, a bell-shape does have a form consistent with facial portraits. For example, the profile of the head and shoulders typically exhibits a "bell-shape". The teachings of Rosenberg could clearly be extended to account for these types of images. Therefore, in order to accommodate for such facial images, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to store the encoded image in a block order that provides a "bell-shaped group layout".

103. *The following is in regard to Claims 75, 77, and 79.* Rosenberg sets blocks outside of the ellipse to a null value of –1. See Rosenberg Figs. 5A-5B and column 16, lines 7-15. Corners of the image are, therefore, truncated,

in the sense that they are nullified by being assigned a negative value. The corners and, moreover, any region outside of the elliptical (or circular or bell-shaped) regions, deemed to correspond to the face, can be considered extraneous.

YCrCb Conversion

104. Claims 7-9 and 36-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ray et al. [089] [089] in view of Anastassiou et al., in further view of [Pennebaker93] (Pennebaker and Mitchell, "JPEG: Still Image Compression Standard", Chapman & Hall, 1993).

105. *The following is in regard to Claim 7 and 36.* As shown above, the smart-card of Ray et al. [089], when modified according to the teachings of Anastassiou et al., conforms to that of Claim 1. Ray et al. [089] and Anastassiou et al., however, are silent as to the particular color space used in their respective inventions.

106. Image data is often converted to YcrCb or YUV prior to compression. JPEG, for example, is a standard image compression algorithm that assumes image data expressed in terms of luminance and chrominance (e.g. YcrCb – [Pennebaker93] Section 2.4.4.2 on pages 18-19), as evidence by the quantization tables depicted in tables 4-1 and 4-2 on page 37 of [Pennebaker93]. An advantage of using *perceptual* color spaces such as YcrCb is that they "provide a relatively uniform perceptual space for describing colors" ([Pennebaker93], page 20, Section 2.4.4.3). In other words, a "fixed" change in the coordinates in such a color space results in uniform changes in the amount of perceived color. This is desirable, according to [Pennebaker93], because the "precision required to express colors to a particular degree of fidelity can be more readily specified in a space with uniform perceptual characteristics" ([Pennebaker93], page 20, Section 2.4.4.3). This, in turn, not only has the effect of improving color reproduction, but also improves the speed and reliability of compression, as well as the achievable compression ratio. Given the clear advantages of using YCrCb and its demonstrated usage in other well-known compression algorithms, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to convert the image data to YCrCb.

107. *The following is in regard to Claim 8 and 37.* As shown above, the smart-card of Ray et al. [089], when modified according to the teachings of Anastassiou et al., conforms to that of Claim 1. Furthermore, in view of

[Pennebaker93], additionally converting the image data to YCrCb would have been represented an obvious modification, at the time of the Applicant's claimed invention. Display devices typically express color in terms of RGB ([Pennebaker93], page 16, Section 2.4.4, paragraph 3). Therefore, in order to facilitate communication with display devices, uncompressed image data is generally used and stored by computer applications in terms of RGB. Taking this into account, as well as the previously stated advantages of YCbCr in compression algorithms, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to provide conversion of the image from an RGB color space to a YCrCb color space. Clearly, for the smart-card to have had any utility within a computer-based application (at least one that utilizes a display device), it must have been capable of accepting RGB data. This would have necessitated the conversion from RGB to YCrCb, if one had desired to take advantage of YCrCb.

108. *The following is in regard to Claim 9 and 38.* Neither of Ray et al. [089], Anastassiou et al., and [Pennebaker93], expressly demonstrate the usage of look-up tables (LUTs) in the conversion from RGB to YCrCb. However, at the time of the Applicant's claimed invention, it was well-known to use LUTs in color conversion. In particular, LUTs have been used to store color values (e.g. YCrCb) mapped from the original color space (e.g. RGB), according to the type of color conversion used (e.g. RGB to YCrCb conversion). By storing pre-computed color values, transformation between color spaces is effectively reduced from executing a complicated set of mathematical calculations to simply indexing a table. For moderately sized color spaces, this substantially reduces the computational burden of the conversion, while not introducing too much storage overhead. Official Notice has been taken. Given the demonstrated usage of LUTs in color conversion and their known advantages, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to convert the image data to the YCrCb color space by lookup tables of selected color values for color space conversion.

109. Claims 10 and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ray et al. [089] in view of Anastassiou et al. and [Pennebaker93], in further view of Sato et al. (U.S. Patent 6,125,199).

110. *The following is in regard to Claims 10 and 39.* As shown above, provided the teachings of Anastassiou et al. and [Pennebaker93], it would have been obvious to one of ordinary skill in the art to incorporate RGB to YCbCr

color conversion into the smart-card of Ray et al. [089] Furthermore, given the state of the art at the time of the Applicant's claimed invention, one would likely implement this color conversion using LUTs. Despite this, neither Ray et al. [089], Anastassiou et al., nor [Pennebaker93] show or suggest converting to YCrCb by using nine 256-entry one-byte lookup tables containing the contribution that each R, G and B make towards the Y, Cr and Cb components. While the usage of LUTs was at the time conventional in color conversion, this particular configuration may not have been.

111. Sato et al. disclose a color correction apparatus and method that employs nine LUTs (i.e. LUT1, LUT2, ..., LUT9 – Sato et al. column 17, lines 12-27 and Fig. 17). The LUTs are used in the conversion of from the R'G'B' color space to the R''G''B'' color space (Sato et al. equation (26) and equation (29) in columns 16 and 17, respectively). The color spaces involved in conversion are unimportant. Rather, it should be clear that this technique of using nine LUTs can apply generally to any color transformation that can be represented as a 3×3 matrix (e.g. equation (27) in Sato et al. column 16)[8]. The equations that govern the transformation from RGB to YCrCb are well known and shown, for example, in the page 3 of the Applicant's Background of the Invention. Clearly, this conversion (as a linear system of three equations in three variables) can be expressed in terms of a 3×3 matrix. Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to apply the color space conversion technique shown in Sato et al. to RGB-to-YCrCb conversion. According to Sato et al., using nine LUTs, in this manner, enables quicker processing (Sato et al. column 17, lines 64-67). This reduction in computational complexity is apparent from equation (29), which shows six addition operations per conversion, as opposed to six additions and nine multiplications (as shown in the page 3 of the Applicant's Background of the Invention). Finally, given this configuration of LUTs, it would have been obvious to

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8 Incidentally, this technique is similar in principle, if not identical, to the manner in which the Applicant uses LUTs in equations (1)-(9) and the subsequent three equations on page 19 of the specification. To realize this first note that the transformation from RGB to YCrCb – shown, for example, on page 3 of the Applicant's Background of the Invention – can be expressed as a 3×3 matrix. Such a matrix would be analogous to that of Sato et al. equation (27). Equations (1)-(9) of the Applicant are analogous to those shown in Fig. 17 of Sato et al. According to Sato et al., the matrix elements (i.e. M_{11}, M_{12}, M_{13}, ..., M_{33}), which are related to the coefficients of the color transformation (i.e. R'G'B'-to-R''G''B''), scale the index into the respective LUT. Analogously, the scalars (e.g. 0.263, 0.516, etc.) represent matrix elements of the 3×3 matrix corresponding to the RGB-to-YCrCb transformation, and relate to the coefficients of the equations shown in page 3 of the Applicant's specification. Notice that these scalars, like $M_{11}...M_{33}$ of Sato et al., multiply the indices (i.e. i) of the respective LUTs. Finally, it should be apparent that the equations that follow equations (1)-(9) of the Applicant are analogous to (29) of Sato et al. If one were to substitute the expressions for LUT1...LUT9 shown in Fig. 17 of Sato et al. into (29), one would arrive at a set of equations having a similar form to those shown on page 3 of the Applicant's Background of the Invention. A similar expansion could be performed using equations (1)-(9) of the Applicant and the equations immediately following. The result would be the same.

one of ordinary skill in the art, at the time of the Applicant's claimed invention, to use 256-entry one-byte lookup tables in order to accommodate a 24-bit color depth, wherein each of the three color components is represented by a byte (8-bits). Each color component, in this case, can take on 256 (2^8) possible values. Therefore, a 256-entry one-byte LUT would have been the minimal dimension LUT necessary (i.e. the optimal choice in terms of LUT dimensionality) to accommodate all possible color values in a 24-bit color.

Block Truncation Coding

112. Claims 6, 11-14, 52-55, and 57-58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ray et al. [089] in view of Anastassiou et al., in further view of [Delp79].

113. *The following is in regard to Claims 6 and 52.* As shown above, Ray et al. [089] and Anastassiou et al. can be combined so as to satisfy the limitations of Claims 1 and 34. However, neither Ray et al. [089] nor Anastassiou et al. expressly show or suggest:

> Statistically encoding the image data by dividing the image into an array of 4×4 squares of pixels, and encoding each 4×4 square of pixels into a fixed bitlength block containing a central color value, color dispersion value, and a selection map that represent the sixteen pixels in the block.

114. [Delp79] introduces the well-known *block-truncation coding* (BTC) method for image compression. The method essentially:

(6.a.) Divides the image into an array of 4×4 squares of pixels ([Delp79], Section II, paragraph[9] 1, sentence 1).

(6.b.) Encodes each 4×4 square of pixels into a fixed bitlength block ([Delp79] (e.g. [Delp79], page 1336, right column, lines 5-10). Each block contains:

1. Central color value (i.e. the mean or first moment, $\overline{X}$ – see equation (1) on [Delp79]

9 When referring to paragraphs in the cited references, the convention followed here is that the paragraph number is assigned to paragraphs of a given column (if applicable) or section, sequentially, beginning with the first full paragraph. Paragraphs that carry over to other columns will be referred to as the last paragraph of the column in which they began.

page 1336).

2. Color dispersion value (i.e. the variance, $\overline{\sigma}^2$ – see equation (1) on [Delp79] page 1336).

3. Selection map that represent the sixteen pixels in the block (i.e. the *n×n bit-plane* – see [Delp79], page 1336, right column, lines 3-5).

Items (6.b.1.)-(6.b.3.) are statistical values of the image and, therefore, imply that the BTC is a statistical encoding method. According to [Delp79], the BTC method of compression is an efficient, effective, and simple to implement method of image data compression (see [Delp79], Section V. *Performance Evaluation of BTC*). Perhaps, the most attractive property of BTC is that it preserves the local statistics of an image ([Delp79], page 1335, Section I., paragraph 2, last sentence). Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to use the BTC method, in lieu of VQ which is more complicated and slower, as the method of image compression in the smart-card discussed above. Similar arguments apply to Claim 52.

115. *The following is in regard to Claim 11 and 53.* As shown above, each block in BTC contains a central color value and a color dispersion value. This was addressed fully above.

116. *The following is in regard to Claim 12 and 54.* As stated above, BTC, according to [Delp79], uses the first sample moment ($\overline{X}$) of each block as the central color value. From equation (1) of [Delp79], it should be clear that the first moment, $\overline{X}$, is the arithmetic mean of the pixels in the block.

117. *The following is in regard to Claim 13 and 57.* As just shown, BTC determines the first sample moment of each block as the arithmetic mean of the pixels in the block. BTC also involves the computation of a second sample moment of the pixels in the block (i.e. $\overline{X^2}$ – see [Delp79] equation (1) on page 1336), and determining the selection map (bit-plane) from those pixels in the block having values lighter or darker than the first sample moment ($X_{th} = \overline{X}$ – see [Delp79], page 1336, left column, paragraph 5, equation (2), and right column, lines 1-5).

118. *The following is in regard to Claims 14 and 58.* As shown previously, BTC involves determining a first sample moment of each block as the arithmetic mean of the pixels in the block, determining a second sample moment of the pixels in the block, and determining said selection map from those pixels in the block having values

lighter or darker than the average ($\overline{X}$) of the block. $\overline{X}$ is not, however, explicitly disclosed in [Delp79] as being the average of the lightest and darkest pixels in the block.

119. Assuming that the color of a block is relatively uniformly distributed within the block, the mean of the block ($\overline{X}$) can be adequately approximated by the average of the maximum value (lightest) of the block and the minimum value (darkest) of the block. This is a valid assumption in most images if the block size is chosen to be sufficiently small. The 4×4 blocks used in BTC would likely satisfy this criterion for most images. Clearly, taking the average of two values (i.e. the maximum value (lightest) of the block and the minimum value (darkest) of the block) is much less computationally expensive than taking the average of all pixels in the block (as in equation (1) of [Delp79]). Therefore, assuming the circumstances discussed above (i.e. uniformly distributed color within the block) hold for a given image, the average of the lightest and darkest pixels of a block is a simpler alternative to the more complicated computation of $\overline{X}$. In the interest of minimizing the complexity of the BTC algorithm, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to set $X_{th} = \overline{X}$ in the BTC method of [Delp79], where $\overline{X}$ is the average of the lightest and darkest pixels in the block. In doing so, the selection map would be determined from those pixels in the block having values lighter or darker than the average of the lightest and darkest pixels in the block.

120. *The following is in regard to Claim 55.* As shown in equation (1) on page 1336 of [Delp79], a second sample moment of the pixels in the block is determined (i.e. $\overline{X^2}$), and said color dispersion value of each said block (i.e. $\overline{\sigma}^2$) is determined by determining the standard deviation (i.e. $\overline{\sigma}$ – see [Delp79], page 1336, right column, lines 3-5) from said first and second sample moments (i.e. $\overline{\sigma}^2 = \overline{X^2} - \overline{X}^2$ – see equation (1) of [Delp79]).

<u>*Absolute Moment Block Truncation Coding*</u>

121. Claim 56 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ray et al. [089] in view of Anastassiou et al. and [Delp79], in further view of [Lema84] (Lema and Mitchell, "Absolute Moment Block Truncation Coding and Its Application to Color Images", IEEE 1984).

122. *The following is in regard to Claim 56.* As shown above, BTC can applied to the image data of the Ray et al. [089]'s smart-card (modified to include the filtering of Anastassiou et al.) to yield a smart-card that conforms to the limitations of claim 54. However, neither Ray et al. [089], Anastassiou et al., nor [Delp79] show or suggest statistically encoding the image data by determining a first absolute moment by determining an average of the difference between the pixel values and the first sample moment, and wherein the color dispersion value is set to the first absolute moment.

123. [Lema84] introduces Absolute Moment Block Truncation Coding (AMBTC) method of image quantization. This method involves encoding the image data by determining a first absolute moment (i.e. $\bar{\alpha}$ – [Lema84] equation (6) on page 1149) by determining an average of the difference (see [Lema84] equation (6) on page 1149) between the pixel values and the first sample moment (i.e. $\bar{\eta}$ – [Lema84] equation (6) on page 1149), and wherein the color dispersion value is set to the first absolute moment (see [Lema84], page 1149, left column, Section II., paragraph 3). According to [Lema84], the usage of the absolute first moment in AMBTC results in a significant reduction in computational complexity over regular BTC ([Lema84], Section IV. *Advantages of AMBTC*). Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to not only use BTC as suggested above, but to use the AMBTC variant proposed by [Lema84].

Multi-Level/Hierarchical BTC

124. Claims 15 and 18-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ray et al. [089] in view of Anastassiou et al., in further view of [WuColl91] (Wu and Coll, "BTC-VQ-DCT Hybrid Coding of Digital Images", IEEE 1991).

125. *The following is in regard to Claim 15.* As shown above, the smart-card of Ray et al. [089], when modified according to the teachings of Anastassiou et al., conforms to that of Claim 1. However, neither Ray et al. [089] nor Anastassiou et al. expressly show or suggest:

> Statistically encoding the image by dividing the image into an array of 4×4 squares of pixels, and multi-level encoding the central color values of each 4×4 square of lower

level blocks.

126. [WuColl91] discloses a compression algorithm that combines the attributes of BTC, VQ, and discrete cosine transform (DCT) coding ([WuColl91], Section I, paragraph 1). Following the discussion above relating to BTC, the compression algorithm of [WuColl91] involves statistically encoding the image by dividing the image of 4×4 squares of pixels. See also [WuColl91], page 1283, Section II, paragraph 1 (*Phase I*). Multi-Level encoding of the central color values (means) of each 4×4 square of lower level blocks is accomplished in the following way:

1. The means of the blocks are grouped into two sub-images – one of high means, the other of low means ([WuColl91], page 1284, Section C., paragraph 1, sentence 1). In this manner, a hierarchy is established consisting of "high level blocks", corresponding to the high-mean blocks, and "lower level blocks", corresponding to low-mean blocks.
2. DCT encoding the high-mean sub-image and the low-mean sub-image ([WuColl91], page 1284, Section C., paragraph 1).

Clearly, this process represents a "multi-level" encoding scheme of the central color values. DCT encoding can also be considered multi-level, in the sense that quantization levels for regions of the encoded sub-images are assigned according to the region's perceptual importance (i.e. high-frequency regions are quantized more coarsely than low-frequency regions). Seen in this light, the BTC-VQ-DCT Hybrid Coding of [WuColl91] involves multi-level encoding (e.g. DCT encoding) of the central color values (means) of each 4×4 square of lower level blocks (i.e. low-mean blocks). According to [WuColl91], their BTC-VQ-DCT algorithm is superior to VQ, in terms of computational complexity and coding delay (see [WuColl91] Section III.A and III.B on pages 1284-1285), while still remaining competitive in terms of NMSE performance (see [WuColl91], Section III.C on pages 1285-1286). The former would clearly be more desirable if the compression algorithm were to be implemented in hardware. Given its advantages over VQ, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to use the BTC-VQ-DCT of [WuColl91], in lieu of VQ, in the smart-card of Ray et al. [089]

127. *The following is in regard to Claim 18.* Each successive lower level block (e.g. each block from the low-mean sub-image S_L – see [WuColl91], page 1284, right column, paragraph 1), according to BTC-VQ-DCT, is

reduced to the residuals (i.e. $S_{H-L} = S_H - S_L$, or $S_{H-L} = S_H - S_{\hat{L}}$) from the encoded block on the level above (i.e. S_H). See [WuColl91], page 1284, paragraph 1-4.

128. *The following is in regard to Claim 19.* As just shown, the pixel values, in the BTC-VQ-DCT of [WuColl91], are reduced to the residuals (e.g. $S_{H-L} = S_H - S_{\hat{L}}$) from the encoded lower level blocks.

129. Claims 59 and 61 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ray et al. [089], Anastassiou et al., and [Delp79], as applied to Claim 54 above, in further view of [WuColl91] (Wu and Coll, "BTC-VQ-DCT Hybrid Coding of Digital Images", IEEE 1991).

130. *The following is in regard to Claim 59.* As shown above, BTC can applied to the image data of the Ray et al. [089]'s smart-card (modified to include the filtering of Anastassiou et al.) to yield a smart-card that conforms to the limitations of claim 54. However, neither Ray et al. [089], Anastassiou et al., nor [Delp79] show or suggest statistically encoding the image by encoding two levels of blocks of each 4×4 square of pixels, including level one blocks and level two blocks, wherein the level two blocks are encoded from the central color values of the level one blocks.

131. As discussed above, [WuColl91] discloses a so-called BTC-VQ-DCT, where two levels of blocks of each 4×4 square of pixels (e.g. low-mean blocks, S_L, and high-mean blocks, S_H) are encoded, including level one (S_H) blocks and level two (S_L) blocks. The level two blocks are encoded from the central color values (means) of the level one blocks. See the discussion above with regard to Claims 18-19. See also [WuColl91], page 1284, paragraph 1-4. According to [WuColl91], the BTC-VQ-DCT is capable of achieving much higher compression ratios than BTC alone (cf. [WuColl91], Abstract, last sentence and [WuColl91], page 1284, left column, paragraph 1, last sentence), while still maintaining the edge-preserving characteristics of BTC ([WuColl91], page 1287, *Conclusion*). Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to not only use BTC, but to use the BCT-VQ-DCT variant proposed by [WuColl91].

132. *The following is in regard to Claim 61.* As shown above with respect to Claim 19, according to BTC-VQ-DCT, the level one blocks (i.e. the high-mean blocks S_H) are reduced to residuals (e.g. $S_{H-L} = S_H - S_L$) from decoded level two blocks (i.e. the low-mean blocks S_L).

Hierarchical BTC with Codebook Compression and Classification

133. Claims 60 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ray et al. [089], in view of Anastassiou et al., [Delp79], and [WuColl91], in further view of [Monro97] (Monro, Li, and Nicolls, "Object Based Video with Progressive Foreground", IEEE 1997).

134. *The following is in regard to Claim 60.* As shown above, BTC-VQ-DCT can applied to the image data of the Ray et al. [089]'s smart-card (modified to include the filtering of Anastassiou et al.) to yield a smart-card that conforms to the limitations of claim 59. However, neither of Ray et al. [089], Anastassiou et al., [Delp79], and [WuColl91] expressly show or suggest that level two blocks are reduced to residuals from a fixed background color.

135. [Monro97], on the other hand, disclose a compression method, wherein images are divided into so-called *macroblocks* and compared to a stored background model. Those whose mean square difference (i.e. residual), MSD, exceed a noise threshold are considered as foreground, and are subsequently split into successively finer partitions described by a quadtree. This gives a set of so-called *microblocks* of variable sizes. The microblocks are then DCT encoded. ([Monro97], Abstract). Clearly, for simple, flat backgrounds the stored background model could be simply set to a predefined color. Furthermore, it should be apparent that the residual from a fixed background color (i.e. the MSD) is in essence captured by the structure of the quadtree.

136. It is well-known that the advantage of quadtree decomposition, with respect to image data compression, is that it allows perceptually significant portions (e.g. the foreground) of the image to be encoded with a finer resolution than insignificant portions (e.g. the background). This results in perceptually superior allocation of quantization bits. Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to perform the quadtree segmentation as proposed by [Monro97] and perform BTC-VQ-DCT, as opposed to DCT alone. The motivation for using BTC-VQ-DCT over DCT would have been to exploit

the advantages of the former over DCT. These were shown in [WuColl91] and discussed above. In this case, the level two blocks would be reduced (decomposed) to residuals (e.g. the MSD) from a fixed background color.

137. Claims 20-21, 23, 31, and 62-63 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ray et al. [089] in view of Anastassiou et al. and in further view of [Franti95] (Franti and Nevalainen, "Block truncation coding with entropy coding", IEEE 1995).

138. *The following is in regard to Claims 20 and 62.* As shown above, the smart-card of Ray et al. [089], when modified according to the teachings of Anastassiou et al., conforms to that of Claim 1. Ray et al. [089] and Anastassiou et al., however, are silent as to the image data being statistically encoded by determining a classification of each block, quantifying each block, and compressing each block by codebook compression using minimum redundancy, variable-length bit codes.

139. [Franti95] disclose a hierarchical BTC (HBTC) method, wherein entropy encoding is applied for both the quantization data (e.g. the first and second moments and bit plane discussed above – see [Franti95], Section 2). Furthermore, as shown in Section 3 of [Franti95], HBTC involves classifying each block by comparing its to a threshold standard deviation σ_{th}. This results in blocks being classified as high-variance ($> \sigma_{th}$) or low-variance ($< \sigma_{th}$). Hierarchical decomposition is performed based on this classification. The advantages of BTC over VQ were discussed extensively above. The advantage of HBTC, in particular, is that it allows a superior allocation of bits to perceptually significant ($> \sigma_{th}$) regions ([Franti95], Section 3, paragraph 2). Therefore, in an attempt to exploit these advantages, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to use the BTC method, in lieu of VQ as the method of image compression in the smart-card of Ray et al. [089]

140. Though not explicitly shown in [Franti95], certain entropy encoders are known to use codebooks and produce minimum redundancy, variable-length bit codes. Huffman encoding is a well-known entropy encoding method that exhibits these characteristics. Huffman encoding removes redundancy from the derived codes. In other words, the smallest possible code-length is assigned to the input data. Official Notice has been taken. Given this and

the pervasiveness of Huffman encoding, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to use Huffman encoding as the entropy encoder in the HBTC of [Franti95].

141. The subject matter set forth in Claim 62 is merely a combines that of Claims 1 and 20. Therefore, the arguments presented above with respect to Claims 1 and 20 are applicable to Claim 62.

142. *The following is in regard to Claim 21 and 63.* As mentioned above, the HBTC of [Franti95] classifies each block by comparing its to a threshold standard deviation σ_{th}. This results in blocks being classified as two categories: high-variance ($> \sigma_{th}$) or low-variance ($< \sigma_{th}$) blocks.

143. *The following is in regard to Claim 23.* Notice that the coding of the quantization data (i.e. mean and standard deviation – Section IV of [Franti95]) and the coding of the bit-plane (see Section V of [Franti95]) occurs after HBTC and the associated classification (e.g. **IF** $\sigma<\sigma_{th}$ - see pseudo-code in [Franti95], Fig. 1). Again, this coding (e.g. Huffman coding – see above), results in variable-length codes. In this manner, the number of bits to be preserved (as determined by the entropy encoder) is determined for each component (mean, standard deviation, and bit-plane) of the block after each the block is classified.

144. *The following is in regard to Claim 31.* In performing quadtree decomposition, the HBTC quantized and entropy encoded image data is stored in a quadtree or, in other words in level order. The advantages of the quadree decomposition of [Franti95] were discussed above. Taking them into account, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to perform HBTC and entropy encoding of the image data, thereby, storing the encoded image data in a quadtree, in level order.

145. Claims 24-25 and 65-69 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ray et al. [089] in view of Anastassiou et al. and [Franti95], as applied to Claim 20 above, in further view of Ribas-Corbera et al. (U.S. Patent 6,111,991).

146. *The following is in regard to Claim 24.* As shown above, when HBTC and an entropy encoder, such as an Huffman encoder, are used for image compression in the smart-card of Ray et al. [089], the resultant smart-card conforms sufficiently to the limitations of claim 23. However, neither of Ray et al. [089], Anastassiou et al., and

[Franti95] explicitly show that the number of bits to be preserved is determined for each component of the block according to the classification of the block.

147. Several compression algorithms (e.g. JPEG, MPEG) were available, at the time of the Applicant's claimed invention, that involved adaptively allocating the number of bits to blocks of pixels, according to some block or pixel classification scheme (e.g. classification based on activity or perceptual importance). Ribas-Corbera et al., for example, discloses a method based on this principle. Ribas-Corbera et al. discloses a method that assigns an optimal number of bits to each block of an image, by identifying the number of bits B_i (Ribas-Corbera et al. column 4, equation (2)) invested in a given block. Each block i has associated with it a variance (σ_i) and a mean ($\overline{P_i}$). See Ribas-Corbera et al. column 4, equations (3) and (4) and Fig. 2. From equation (2) of Ribas-Corbera et al. it can be seen that the number of bits allocated to a block is dependent on the associate variance of the block. The variance is known to be a measure of the activity contained in a region of an image. Ribas-Corbera et al. refers to this as *image information* or *energy* (Ribas-Corbera et al. column 3, lines 52-58). Blocks are, therefore, classified according to the amount of image information or energy they contain. In this manner, the number of bits to be preserved for each component of the block is determined according to the classification of the block.

148. The advantage to this adaptive allocation is that regions containing dense image information are allocated more bits (quantization levels) than regions having little information. Clearly, the result is a reduction in the overall number of bits necessary to encode the image while maintaining acuity in regions of perceptual importance. Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to configure the entropy encoder used in the HBTC of [Franti95] such that the BTC encoded blocks (and, hence, their components) are allocated bits according to their classification, which was shown above (and in both [Franti95] and Ribas-Corbera et al.) to depend on the blocks' variance.

149. *The following is in regard to Claims 25 and 65.* Though not explicitly discussed by [Franti95] or Ribas-Corbera et al., the number of bits allocated for the Y and Cr/Cb components of the blocks are determined independently for each classification. This is because, intuitively, each block must contain information (e.g. mean, variance, and bit-plane), independently, for each of the constituent color components. Therefore, assuming a YCrCb color representation, the number of bits allocated for the Y and Cr/Cb components would be determined

independently for each classification, by virtue of the bit allocation scheme discussed previously. Similar arguments can be made for Claim 65.

150. *The following is in regard to Claims 26-28 and 66-68.* Note that the mean, variance and bit-plane associated with each of the BTC-encoded blocks are not discarded according to any of the methods discussed above (i.e. HBTC, entropy encoding, and the method of Ribas-Corbera et al.). Therefore, *regardless of their classification*, the mean, variance, and bit-plane are preserved for each color component of the BTC-encoded blocks. This addresses the subject matter of claims 26-28 because all of the claimed "preserved"-components are preserved, as just shown. Similar arguments apply, respectively, to Claims 66-68.

151. *The following is in regard to Claims 29 and 69.* Though neither Ray et al. [089], Anastassiou et al., [Franti95] or Ribas-Corbera et al. explicitly show:

> Recording the run length of blocks exhibiting little or no change from the higher level or previous frame (i.e. "null blocks"), without preserving components of the null blocks (i.e. essentially performing run-length encoding (RLE) on the null blocks).

RLE was known, at the time of the Applicant's claimed invention, to be useful in encoding strings of redundant or repeating data (i.e. *runs*). RLE functions by replacing runs of the same data with a count or *run-length* indicating the number of times that data repeats. Because the data is repetitious, only the run-length is preserved along with a code representing the data that is repeated. RLE is attractive because it is very fast and the resulting codes are extremely compact. Official Notice has been taken. Since null blocks represent redundant data (i.e. they exhibit little or no change from the higher level, etc.), it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to run-length encode null blocks. By applying RLE to null blocks, the encoded null blocks that result would include a run-length, without preserving the components of the original null block.

<u>*Pattern Matching*</u>

152. Claim 70 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ray et al. [089] in view of Anastassiou et al. and [Franti95], as applied to Claim 62 above, in further view of Arai et al. (U.S. Patent 6,122,402).

153. *The following is in regard to Claim 70.* As shown above, when HBTC and an entropy encoder, such as an Huffman encoder, are used for image compression in the smart-card of Ray et al. [089], the resultant smart-card conforms sufficiently to the limitations of claim 62. However, neither Ray et al. [089], Anastassiou et al. nor [Franti95] disclose matching a texture map of a block with one of a plurality of common pattern maps for uniform chroma and pattern classified blocks.

154. Arai et al. disclose a "pattern matching encoding" method wherein a texture map (e.g. extracted patterns – see Arai et al. Fig. 2 (step1) and column 3, lines 19-28) of a block is matched (Arai et al. Fig. 2 (step 2) and column 3, lines 29-38) with one of a plurality of common pattern maps (e.g. "accumulated" or library patterns – Arai et al. Fig. 2 (step 2) and column 3, lines 29-38). Patterns, by nature, correspond to image data that has significant variation in either of its luminance (significant luminance component to the standard deviation as in "uniform chroma blocks") and chrominance components (as in pattern classified blocks). If a match is found, then the extracted pattern is represented by a coded index corresponding to the matched library pattern (Arai et al. column 5, lines 25-65). If, on the other hand no match occurs, the pattern is encoded by a transform encoding method (e.g. JBIG – Arai et al. column 6, lines 10-18). Thus, the encoding of image data is reduced to a simple pattern matching process, in certain case. Furthermore, common patterns found in the image are encoded simply as coded indices into a library. According to Arai et al. (Arai et al. column 7, line 1-6), this reduces the overall size of the encoded image and improves encoding efficiency. Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to additionally perform the pattern matching encoding of Arai et al. in the smart-card of Ray et al., to locate and encode common patterns in the image.

Bit Allocation Per Classification

155. Claim 71 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ray et al. [089] in view of Anastassiou et al. and [Franti95], as applied to Claim 62 above, in further view of [ChenPratt84] (Chen and Pratt, "Scene Adaptive Coder", IEEE 1984).

156. *The following is in regard to Claim 71.* As shown above, when HBTC and an entropy encoder, such as an Huffman encoder, are used for image compression in the smart-card of Ray et al. [089], the resultant smart-card

conforms sufficiently to the limitations of claim 62. Though it was known at the time of the Applicant's claimed invention to use and select among multiple codebooks based on the content of an image or regions of an image (e.g. as in JPEG or certain VQ algorithms), this is not expressly shown by Ray et al. [089], Anastassiou et al. and [Franti95].

157. [ChenPratt84] disclose a transform-based image coder ([ChenPratt84] Abstract), wherein the quantization data is coded using a Huffman encoder ([ChenPratt84], page 226, Section III, paragraph 1, sentence 4). [ChenPratt84] make use of two Huffman tables or codebooks, one for the DC quantization data (i.e. non-zero DCT coefficients) and the other for the AC quantization data (i.e. zero DCT coefficients)[10].

158. Different techniques can be used to quantize the data according to their effectiveness or efficiency at quantizing that data. In [ChenPratt84] DCT is used for DC image data, whereas DCT and run-length encoding (RLE) is used for AC image data. Notice, however, that the values obtained according to the two quantization methods are not unique (i.e. DCT and RLE may produce the same results). [ChenPratt84] resolves this by using multiple Huffman tables, thereby allowing the DCT and RLE data to be Huffman encoded. In other words, Huffman encoding quantization data, obtained by multiple quantization algorithms, necessitates multiple Huffman tables. Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to use multiple Huffman tables in the HBTC of [Franti95] so as to support multiple quantization algorithms, which may be selected according to their efficiency or effectiveness at quantizing particular classes of image data.

Chroma-keying, Background Segmentation, Morphological Opening

159. Claims 43-45, 47, and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ray et al. [089] and Anastassiou et al., as applied to Claim 35 above, in further view of [ChenSwain97] (Chen , Swain and Haskell, "Coding of Sub-Regions for Content-Based Scalable Video", IEEE 1997).

10 It is generally accepted that, when transforming an image to the DCT domain, the DC coefficients (low-frequency) correspond to regions of the image that are perceptually more important than regions corresponding to the AC (high-frequency) coefficients. Therefore, although the teachings of [ChenPratt84] relate to DCT quantization, the usage of multiple Huffman tables corresponding to perceptually important and unimportant quantization data.

160. *The following is in regard to Claim 43.* As shown above, the smart-card of Ray et al. [089], when modified according to the teachings of Anastassiou et al., conforms to the limitations set forth in Claim 35. However, neither Ray et al. [089] nor Anastassiou et al. expressly show or suggest replacing the background of the image being compressed is with a scalar value, in order to reduce noise in the image, and to increase the visual quality of the compressed image[11].

161. [ChenSwain97] discloses a scheme for coding sub-regions in images (video frames). The method relies on a technique called *chroma-keying* ([ChenSwain97] Abstract). According the coding scheme, the background ($\overline{\mathcal{R}_i}$) of the image is replaced by a scalar value (i.e. the color C_0, referred to hereinafter as the *chroma-key*). See [ChenSwain97] Section II, paragraph 2. This, according to [ChenSwain97], allows the content of interest (i.e. the foreground) to be selectively encoded and decoded, a property referred to in the MPEG community as *content-based scalability* ([ChenSwain97] Section I, paragraph 1, last sentence and paragraph 2). Taking this into account, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to selectively encode the foreground region of the image stored on the smart-card of Ray et al. [089], according the methodology of [ChenSwain97].

162. *The following is in regard to Claim 44.* As stated above, [ChenSwain97] replace the background of the image being compressed with a scalar value. This is done, in part, by identifying a background region $\overline{\mathcal{R}_i}$ as the set of colors within a threshold (T) distance about the chroma-key C_0. See [ChenSwain97] page 257, left column, paragraph 1, sentences 2-3.This region ($\overline{\mathcal{R}_i}$) can be regarded as the "chroma-key mask" since it defines the background region of the image.

163. "Delta values" are understood here to be values which define a region in the color space corresponding to the background of the image. The background region is given mathematically as $\{\mathbf{x} \mid d[\hat{g}(\mathbf{x}, n), C_0] \leq T\}$. This follows trivially from the definition of the foreground ($\hat{\mathcal{R}}_i$) given in [ChenSwain97] equation (2). In this case, T can be taken as the delta value defining the background region. In summary, [ChenSwain97] replaces the background, via chroma-keying, by setting an initial chromakey mask (i.e. $\overline{\mathcal{R}_i}$) and delta values (e.g. T).

11 Note that the phrase "in order to reduce noise in the image, and to increase the visual quality of the compressed image" only functionally limits the subject matter of Claim 43.

164. *The following is in regard to Claim 45.* Following the previous discussion it should be clear that the chroma-key mask ($\overline{\mathcal{R}_i}$) is determined by the pixels (**x**) in the input image that are near (i.e. within a threshold distance T of) the chromakey value (C_o).

165. *The following is in regard to Claim 47.* As pointed out above, $\overline{\mathcal{R}_i} = \{\mathbf{x} \mid d[\hat{g}(\mathbf{x}, n), C_0] \leq T\}$. This, in fact, defines a solid sphere of radius T about the chroma-key C_0. In this manner, one delta component (T) describes a spherical region in the color space. YCrCb is a well-known color space and has the advantage of being a perceptually-based (see above). Official Notice is taken. Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to use a YCrCb color space representation. If YCrCb were used then the delta component T of [ChenSwain97] describes a spherical region in the YCrCb color space.

166. *The following is in regard to Claim 49.* In the method of [ChenSwain97], once a mask has been found, artifacts (e.g. color bleeding artifacts, etc.) are remove from its boundary. See page 258 of [ChenSwain97], Section IV, paragraph 1 and Section IV.B.

167. Claims 46 and 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ray et al. [089], Anastassiou et al. and [ChenSwain97], as applied to Claim 45 above, in further view of Uya (U.S. Patent 5,838,310).

168. *The following is in regard to Claim 46.* As shown above, the smart-card of Ray et al. [089], when modified according to the teachings of Anastassiou et al. and [ChenSwain97], conforms sufficiently to the smart-card proposed in Claim 45. However, neither Ray et al. [089], Anastassiou et al., nor [ChenSwain97] explicitly show that three delta components describe a rectangular region in YCrCb color space.

169. Uya teaches that, in chroma-keying, a rectangular volume (e.g. a cube) may be defined in RGB space to delimit a region of the color space corresponding to the background (e.g. a bluescreen). See Uya column 1, paragraph 2. Clearly, these teachings can be applied to any analogous Cartesian color space (e.g. YCrCb). Furthermore, rectangular volumes require three parameters (i.e. "delta values") to define them – namely, the width, height, and length. Given the teachings of Uya, it would have been obvious to one of ordinary skill in the art, at the

time of the Applicant's claimed invention, to define the chroma-key mask ($\overline{\mathcal{R}}_i$) of [ChenSwain97] as a rectangular volume in YCrCb space. As mentioned above, such a representation necessitates three delta values – namely, the extents of the volume along each of the three axes Y, Cr, and Cb.

170. *The following is in regard to Claim 48.* Neither of the aforementioned authors show or suggest the usage of an HSV color space representation. HSV is widely used in computer graphics and image processing. It has several known advantages over other color spaces. In particular, hue (H) and saturation (S) are intrinsic components of this representation. These are intimately related to the manner in which humans perceive color. Official Notice has been taken.

171. HSV is defined in terms of cylindrical coordinates. Intuitively, rectangular volumes of a Cartesian color space map to elliptical cylinders in cylindrical color spaces. Taking this into account it would have be obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, that if Uya's teachings were applied to a HSV color space – say, to take advantage of its aforementioned merits – the rectangular regions would be need to be redefined in terms of corresponding elliptical cylinders. Elliptical Cylinders require three parameters (delta values) to define them – namely, its height, semimajor axis, and semiminor axis.

172. In summary, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to use HSV to define colors in the method of [ChenSwain97] in light of the desirable characteristics of HSV. Furthermore, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed invention, to extend the teachings of Uya to HSV space and apply them (in a manner analogous to their above application to YCrCb) to the method [ChenSwain97]. As shown above, such an application would require defining an elliptical cylinder in terms of three "delta values" – namely the cylinder's height and its semimajor and semiminor axes.

173. Claim 50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ray et al. [089], Anastassiou et al. and [ChenSwain97], as applied to Claim 49 above, in further view of [GonzWoods93] (Gonzalez and Woods, "Digital Image Processing", Addison-Wesley, 1993).

174. *The following is in regard to Claim 50.* [ChenSwain97] use morphological erosion as one means to eliminate artifacts from the boundary of the chroma-key mask ([ChenSwain97] page 258, Section IV.B). As shown above, [ChenSwain97]:

(50.a.) Initially determine the set of pixels constituting the mask $\overline{\mathcal{R}_i}$.

[ChenSwain97] does not, however, explicitly disclose:

Repeating the following steps a plurality of times:

(50.b.) Removing pixels from said mask set that have less than a predetermined threshold of neighboring pixels included in said mask set.

(50.c.) Adding pixels to said mask set that have more than a predetermined threshold of neighboring pixels included in said mask set

175. Morphological *erosion* involves step (50.b.). This is shown in [GonzWoods93] on page 521. The set operations shown in equation (8.4-6) of [GonzWoods93] essentially remove pixels from a mask set (i.e. set *A* in (8.4-6)) that have less than a predetermined threshold of neighboring pixels included in mask set. This predetermined threshold of neighboring pixels is determined by the size and shape of the *structuring element* (i.e. set *B* in (8.4-6)). See [GonzWoods93], page 519, *Dilation*, paragraph 1, last sentence.

176. Morphological *dilation* involves step (50.c.). This is shown in [GonzWoods93] on page 519. The set operations shown in equation (8.4-5) of [GonzWoods93] essentially add pixels to a mask set (i.e. set *A* in (8.4-5)) that have less than a predetermined threshold of neighboring pixels included in mask set. This predetermined threshold of neighboring pixels is determined by the size and shape of the *structuring element* (i.e. set *B* in (8.4-5)).

177. Erosion (step (50.b.)) and dilation (step (50.c.)) are often combined and repeated in a process called *morphological closing*. Closing is used to smooth contours (e.g. the boundary of a mask set – see Fig. 8.28 of [GonzWoods93]) and fuse narrow breaks, gulfs, gaps, and holes in the contour. See [GonzWoods93] page 524, Section 8.4.2, paragraph 1. [GonzWoods93] extend these morphological operations to grey-scale images ([GonzWoods93] pages 548-555), thus showing their applicability to the grey-scale masks of [ChenSwain97]. Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the Applicant's claimed

invention, to use morphological closing (steps (50.b.)-(50.c.)) in the method of [ChenSwain97] to further smooth and eliminate artifacts (e.g. narrow breaks, gulfs, gaps, and holes) from the boundary of background $\overline{\mathcal{R}_i}$.

Citation of Relevant Prior Art

178. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

[1]-[3] disclose quantization and coding methods involving adaptively allocating bits to image blocks in response to block activity and/or variance

[1] *U.S. Patent 6,192,158*. Abousleman. Publication Date: February 2001.

[2] *U.S. Patent 5,613,015*. Suzuki et al. Publication Date: March 1997.

[3] *U.S. Patent 6,356,663*. Korta et al. Publication Date: March 2002.

[4]-[5] disclose chroma-keying methods. [4], in particular, shows the combination of BTC and chroma-keying segmentation.

[4] *U.S. Patent 5,495,297*. Fujimori et al. Publication Date: February 1996.

[5] *U.S. Patent 5,914,748*. Parulski et al. Publication Date: June 1999

[6] *U.S. Patent 5,907,315*. Vhalos et al. Publication Date: May 1999.

[7]-[9] disclose classification VQ algorithms. Classification in these algorithms is based on block activity. Also, these algorithm generally are use at least one codebook.

[7] Lo and Cham, *New Classified Vector Quantization of Images,* IEEE TENCON 1993.

[8] Lo and Cham, *New Predictive Classified Vector Quantization Scheme for Image Compression,* IEEE Electronic Letters, 1994

[9] Ramamurthi and Gersho, *Classified Vector Quantization of Images,* IEEE 1986.

[10]-[14] disclose hierarchical and/or multi-level BTC. [11] inherits from usage of VQ, multiple codebooks that are selected according to block variance.

[10] Overturf and Delp, *Color Image Coding Using Morphological Pyramid Decomposition,* IEEE 1995.

[11] Franti et al., *On the Design of a Hierarchical BTC-VQ Compression System,* Image Communication, Vol 8(6), 1996.

[12] Nasrabadi and Choo, *Hierarchical Block Truncation Coding of Digital HDTV Images,* IEEE 1990.

[13] Kuo and Chen, *Nearly Optimum Multilevel Block Truncation Coding Based on a Mean Absolute Error Criterion*, IEEE 1996.

[14] Wu and Coll, *Multilevel Block Truncation Coding Using a Minimax Error Criterion for High-Fidelity Compression of Digital Images,* IEEE 1993.

[15] *U.S. Patent 6,151,409*. Chen et al. Publication Date: November 2000.

Chen et al. disclose a BTC algorithm involving a simple classification of blocks based on block activity or variance

[16] Ma and Huang, *Perceptually Based Subband AMBTC Image Coder,* ICICS 1997.

[16] discloses a BTC algorithm wherein bits are adaptively allocated based on their perceptual importance (Weber's Law). The algorithm use the absolute moment. [16] also redistributes bits (*residual* bits)

[17] *U.S. Patent 6,262,778*. Nonweiler et al. Publication Date: July 2001.

Nonweiler show the usage of nine LUTs for color space conversion.

Conclusion

Potentially Allowable Subject Matter

179. It was shown above that all structural limitations of Claims 5, 16-17, 22, 30, 33, 42, 51, and 64 were addressed by Ray et al. [089]. These claims, therefore, were rejected under U.S.C. § 103(a) as being unpatentable in view of Ray et al. [089]. However, no prior art was encountered that satisfied the functional limitations of these claims, specifically with respect to the claimed image data. If the claims were rephrased so as to replace the functional language with language that defines structure, as discussed above, then these claims would likely be allowable in light of the deficiencies of prior art. This statement does not, however, preclude the possibility that future searches may reveal relevant prior art.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kevin Siangchin whose telephone number is (703)305-7569. The examiner can normally be reached on 9:00am - 5:30pm, Monday - Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amelia Au can be reached on (703)308-6604. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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